

PROCEEDINGS
OF THE
CALIFORNIA ACADEMY OF SCIENCES
FOURTH SERIES

Festschrift for George Sprague Myers

Vol. XXXVIII, No. 5, pp. 99-103; 1 fig.

December 31, 1970

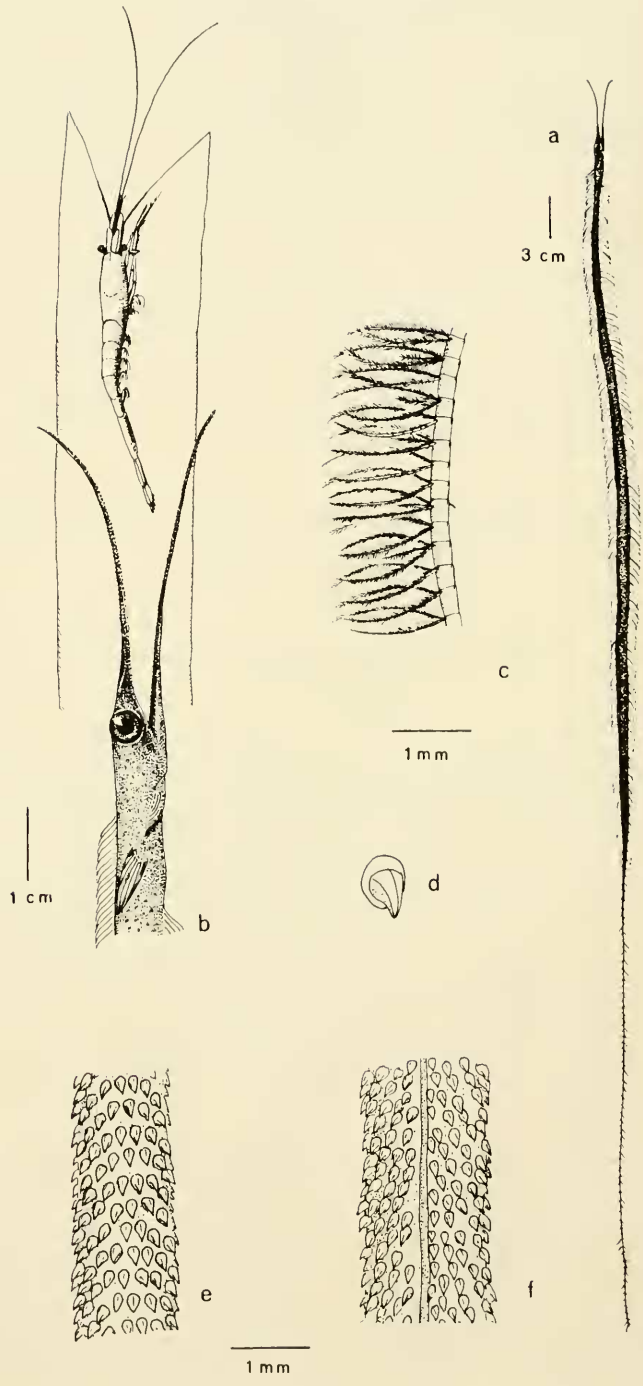
NOTES ON THE NATURAL HISTORY
OF SNIPE EELS

By

Giles W. Mead and Sylvia A. Earle
Harvard University

One cannot fail to be impressed by the adaptations for midwater life developed by the mesopelagic eels, an assemblage doubtless derived from a benthic ancestor. In most the body has become far more attenuated than that of the most elongate of their benthic relatives, the terminal part of many being filamentous and apparently composed of little more than minute and poorly ossified vertebrae covered by thin skin and supporting fine and hair-like fin rays. This attenuation is accomplished by an increase in number of vertebrae rather than an increase in the length of each. An apparently intact specimen of *Nemichthys* taken during the International Indian Ocean Expedition of 1964 had 670 vertebrae—certainly a record number among the vertebrates. Equally extreme are specializations in mouth parts. The teeth, for example, vary vastly in form, number and position.

The more extreme genera such as *Nemichthys*, *Labichthys*, and *Avocettina* are of concern here. All have greatly prolonged jaws (fig. 1b) that bear numerous small teeth laterally as well as dorsally or ventrally (fig. 1d-f), and are usually tipped by flattened bony pads that bear teeth or rugosities on all sides. The jaw teeth are arranged in chevron-shaped consecutive series or, in others, in quincunx. The two halves of the lower jaw are loosely conjoined laterally for most of the length of the mandible. The principal part of the upper jaw, in



contrast to other fishes, is composed of the vomer; and the biting elements of other lower fishes, the maxillae, are reduced to lateral struts that support the base of the prolonged vomerine bar (Beebe and Crane, 1937). The positional relationship of these jaws has been particularly enigmatic, for they diverge forward from the gape so that their tips, and often as much as half of the total length of the jaws, cannot be brought into contact with each other when the mouth is as far closed as it can be. These fishes can but partially close their mouths, yet the distal ends of their jaws, that cannot possibly be brought into contact with each other, bear thousands of small chisel-shaped posteriorly inclined teeth (fig. 1d-e) reminiscent of the shagreen of an elasmobranch. What can be the function of such a structure?

That these jaws are used to funnel microplankton toward the mouth as the eel swims through the water seems unlikely. Lateral movement of the prey by but a millimeter or two would take it beyond the grasp of the predator. To feed in this way, structural adaptation similar to that in the herrings would be more in order. It has also been suggested that these prolonged jaws simply provide greater surface area, and might be considered adaptations for flotation. While we would consider the attenuated but fin-bearing shape of the body the result of selection toward greater surface area that serves the interests of flotation, we are reluctant to so consider the development of well ossified structures richly endowed with small but dense teeth. Such a beak would also seem to be the antithesis of a structure developed in aid of streamlining or locomotion. Nichols and Murphy (1944) repeated a report by Mowbray (1922) of a snapper captured in Bermuda with a 265 mm. representative of *Nemichthys scolopaceus* attached by its slender jaws to the posterior margin of the snapper's caudal fin. Mowbray concluded, "The specimen being taken in this way gives good reason to believe that grasping the tails of fishes is the function of the divergent mandibles of these eels."

We can suggest an alternative function for these diverging and nonocclusable jaws, a suggestion emanating from observations made at mid-depths from the late D.S.R.V. *Alvin* and catches made concurrently by a supporting vessel, R.V. *Gosnold*, both of the Woods Hole Oceanographic Institution. These dives were made between October 2 and 6, 1967, in Slope Water of the western North Atlantic in an attempt to observe visually certain sound-scattering targets at

←

FIGURE 1. a. Snipe eel, *Nemichthys scolopaceus*, in typical vertical position as observed from the D.S.R.V. *Alvin*. b. Vertically oriented specimen of *N. scolopaceus* and sergestid shrimp, *Sergestes* (*Sergestes*) *arcticus*, drawn from specimens taken by R.V. *Gosnold* concurrent with D.S.R.V. *Alvin* observations. c. Distal portion of antenna of *S. (S.) arcticus*. d. Tooth from upper jaw of *N. scolopaceus*. e. Inner surface of upper jaw of *N. scolopaceus*. f. Inner surface of lower jaw of *N. scolopaceus*.

mid-depth (see Backus *et al.*, 1968). Concurrent with these dives, R.V. *Gosnold* fished similar depths with a 10-ft. Isaacs Kidd Midwater Trawl.

Observers aboard *Alvin* frequently saw snipe eels (*Nemichthys*) at depths below 300 m. and confirmed the observations of others that these eels are usually oriented vertically in the water, motionless or but slightly undulating, and usually with their divergent jaws directed upward. Among the other more spectacular animals seen at comparable depths were relatively large sergestid decapods. These too were often suspended vertically in the water, their bright orange-red stomachs and organs of Pesta prominent, the short pleopods beating furiously, and their long antennae extending upward and outward away from the body and then turning abruptly to follow a course parallel to the axis of the body to a point considerably below the tail. Neither eels nor sergestids appeared to be disturbed by the lights of the submarine.

Both sergestids and snipe eels were caught by the nets of the *Gosnold*. The eels belong to *Nemichthys scolopaceus* Richardson, 1848, and the sergestids, kindly identified for us by Mr. Peter Foxton of the National Institute of Oceanography, Godalming, belong to *Sergestes* (*Sergestes*) *arcticus* Kröyer, 1855. Representatives of *Nemichthys*, as usual, were present in the catch with beaks entangled in everything present, living or not. Several were hanging by their beaks from the upper part of the netting as the trawl was raised above the water, the red stomachs of ingested sergestids visible through the semitransparent stomachs and body walls. This material was returned to Woods Hole and to the Museum of Comparative Zoology, Harvard University, for study and is deposited in the latter institution.

The stomach contents of about 160 specimens of *Nemichthys* were examined. In addition to the *Gosnold* collection these included others variously collected in the western North Atlantic and those from the Indian Ocean and off central Chile that were caught during Cruises VI and XIII, respectively, of R.V. *Anton Bruun*. Most stomachs were empty. Those which were not, contained crustacean remains exclusively. An examination of the specimens of *Sergestes* which were available and published accounts of others (Burkenroad, 1934, 1937; Foxton, 1969; Hardy, 1956) revealed the complexity of the prolonged antennae with their multiple sensory hairs, structures admirably suited to aid in flotation.

We believe that the function of the beak of the snipe eels can be added to the list of features in which these eels are unique among vertebrate animals, for we suggest here that these animals feed by entanglement. Given the vast extent and thread-like nature of some appendages of many mesopelagic crustaceans and the set and structure of snipe eel dentition, the evolution of structures adapted for the feeding of one on the other seems reasonable. The antennae of a sergestid if brushed across the bed of teeth of a snipe eel would almost certainly become entangled, and struggle by the prey would only worsen its plight, shorten the

distance between shrimp and fish; and ultimately bring the prey within that more posterior part of the jaws capable of crushing and swallowing movements.

Such a feeding mechanism is consistent with present concepts of midwater ecology. Food in the deep ocean is scarce and energy precious. Hovering and darting, or luring types of predation tend to replace the roving activities more prevalent near the surface. Intake per unit of energy expended must be high if a predator is to survive. What finer an example of adaptation to these conditions can there be than that of these eels: hanging effortlessly with flotation facilitated through attenuation of the body, and with jaws covered by myriads of denticles exquisitely designed to entangle the appendages of passing crustacea, be they moving laterally or, with some, rising or descending as a part of their daily routine.

ACKNOWLEDGMENTS

This note owes its existence to an invitation to one of us to dive aboard *Alvin* and we thus record our grateful appreciation to the Woods Hole Oceanographic Institution and especially to Dr. Richard H. Backus of that institution for that opportunity. In addition to identifying the sergestids, Mr. Peter Foxton, National Institute of Oceanography, Godalming, reviewed the manuscript, as did Drs. Backus, R. L. Haedrich, and J. E. Craddock of the Woods Hole Oceanographic Institution. This paper is contribution number 2351 from the Woods Hole Oceanographic Institution.

REFERENCES

- BACKUS, R. H., J. E. CRADDOCK, R. L. HAEDRICH, D. L. SHORES, J. M. TEAL, A. S. WING, G. W. MEAD, AND W. D. CLARK
1968. *Ceratoscopelus maderensis*: peculiar sound-scattering layer identified with this myctophid fish. *Science*, no. 160, pp. 991-993.
- BEEBE, W., AND J. CRANE
1937. Deep-sea fishes of the Bermuda Oceanographic Expeditions. Family Nemichthyidae. *Zoologica* (N.Y.), vol. 22, no. 4, pp. 349-383.
- BURKENROAD, M. D.
1934. The Penaeidae of Louisiana with a discussion of their world relationships. *Bulletin of the American Museum of Natural History*, vol. 68, no. 2, pp. 61-143.
1937. The Templeton Crocker Expedition XII. Sergestidae (Crustacea, Decapoda) from the Lower California region, with descriptions of two new species and some remarks on the organs of Pesta. *Zoologica* (N.Y.), vol. 22, no. 4, pp. 315-329.
- FOXTON, P.
1969. The morphology of the antennal flagellum of certain of the Penaeidae (Decapoda, Natantia). *Crustaceana*, vol. 16, no. 2, pp. 33-42, 1 pl.
- HARDY, A. C.
1956. *The open sea*. Boston. xv + 335 pages, 18 pls.
- MOWBRAY, L. L.
1922. Habit note on snipe eel. *Copeia* no. 108, page 49.
- NICHOLS, J. T., AND R. C. MURPHY
1944. A collection of fishes from the Panama Bight, Pacific Ocean. *Bulletin of the American Museum of Natural History*, vol. 83, no. 4, pp. 217-260.